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Research Article

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Effect of different nutrient resources on yield and quality of basmati/aromatic rice in inceptisol of Eastern Uttar Pradesh

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Summary

A field experiment was conducted at Crop Research Station, Masodha under Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, (U.P.) during *Kharif* season 2008-2009 to evaluate the productivity and quality of aromatic/basmati rice variety under different nutrient parameters which included the application of nutrients through only chemical fertilizer, only organic source and combination of organic manure and fertilizer, besides the foliar spray of a plant growth retardant (Cycocel) in combination with inorganic fertilizer to reduce plant height. An improved basmati variety vasumathi, a traditional culture, tarori basmati and local non-basmati aromatic rice, Kalanamak were included as a test variety. A significant response of different nutrient resources @ 100:50:50 kg NPK ha^{-1} on rice production and their quality was observed. Use of inorganic fertilizer with cycocel produced maximum grain (3.77 t ha^{-1}) and straw (5.93 t ha^{-1}) yield followed by inorganic fertilizer alone treatment which recorded 3.68 grain and 5.32 straw yield t ha^{-1}. Organic sources applied alone produced minimum grain (3.31t ha^{-1}) and straw (4.94t ha^{-1}) whereas integrated use of organic and inorganic fertilizer treatment significantly improved grain (3.60 t ha^{-1}) and straw (5.03 t ha^{-1}) over organic treatment alone. Among varieties, the improved basmati (Vasumathi) recorded higher grain (3.76 t ha^{-1}) and straw (4.62 t ha^{-1}) yield than traditional tarori basmati which recorded 2.30 t grain/ha and 4.04 t straw/ ha. Whereas maximum grain (4.01t ha^{-1}) and straw (5.18 t ha^{-1}) yield was produced by non-basmati aromatic variety Kalanamak. The influence of nutrients sources on grain quality was significant for kernel dimensions, amylase content and gell consistency. Organic sources in general, were superior to fertilizers in improving grain and the quality parameters and recorded maximum hilling (78.6%), millimg (67.79%), KL (6.74mm), KB (1.84mm), amylase content 26 per cent and gell consistency (61.6 mm). Among varieties, improved basmati (Vasumathi) recorded maximum hilling (79.5 %) and milling (68.6%) fallowed by Kalanamak which recorded 78.2 per cent hulling and 67.6 per cent milling. The minimum grain quality parameters were recorded by traditional tarori basmati grown in Inceptisol of Eastern U.P.

Key words : Basmati rice, Aromatic rice, INM in rice production

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Introduction

Production of high quality aromatic rice by the farmers for domestic as well as export purpose is a major concern of future agricultural strategy. The yield and quality of basmati/ aromatic rice is very much affected by many factors like soil characteristics, agro climatic conditions and nutrient management practices. The cultivation of aromatic rice is mainly confined to the foothills of Himalayas along with some distant pockets in few states of our country (Siddiq, 2002). The export of Basmati/ aromatic rice from India has grown steadily during the last decade. Therefore, there is need to cultivate basamti/ aroamtic rice in non-traditional areas with intensive nutrient management to increase the production of basmati/ aromatic. The integrated use of nutrient not only improved the yield and quality of basmati rice but also reduced the cost of chemical fertilizer by 25 per cent and improved soil health (Mithun *et al.*, 2007). Thus, integrated nutrient management practices may be used to achieve desirable grain quality and maintain sustainable production of basmati/ aromatic rice in new rice production areas of Eastern Uttar Pradesh. Therefore, a study was conducted to study the effect of different nutrient resources practices in Inceptisol of Eastern Uttar Pradesh on productivity and quality of Basmati/aromatic.

Resource and Research Methods

A field experiment was conducted at crop research station, Masodha under Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) during *Kharif* season 2008-2009 to study the effect of different nutrient resources on yield and quality of aromatic/basmati rice in Inceptisol of Eastern Uttar Pradesh. The experimental site was under Inceptisol of well drained alluvial soil having sandy loam in texture pH 7.7, organic carbon 4.2 g kg^{-1}, CEC 13.80 Cmol (p^{+}) kg^{-1}, EC 1.02 dSm^{-1} and available N, P and K were 227, 29 and 130 kg ha^{-1}, respectively. In all, 12 treatment combinations consist 4 nutrient management practices and three aromatic rice varieties were laid out in Split Plot Design with three replications having different nutrient resources as main plot and rice varieties as sub plot treatments. The nutrient management practices were, 100 % RDF (100:50:50 kg NPK ha^{-1}), 75 % RDF + 25 % as organic manure (FYM), 100% organic manure (10tFYM ha^{-1}) and 100 % RDF + foliar spray of cycocel (plant growth retardant). Three rice varieties *viz.*, vasumathi, an improved basmathi variety, tarori basmati, a traditional basmati and Kalanamak as local check were included as test varieties. Seeds were shown on 6th and 8th June in 2008 and 2009, respectively in seed bed. Twenty five days old seedling were transplanted in puddle field at 20 x 15 cm spacing with 2-3 seedling $hill^{-1}$ in experimental plot of 5 x 4 m size. The crop was harvested at the end of October. One third of recommended dose of N and full dose of P and K were applied as basal. The remaining 1/3 N at tillering and 1/3 at panicle initiation stage were given as top dressing. The organic manure was applied at the final land preparation as per treatment schedule. Cycocel was sprayed after 30 and 45 days of transplanting to reduce plant height. Continuous submergence of 2-3 cm water was maintained at transplanting; at later stage 3-5 cm submergence was maintained up to maximum tillering stage. Withdrawal of submergence was done 15 days before harvesting. The other agronomic practices were followed as per standard recommendations. Yield parameters were recorded along with grain and straw yield. Quality tests of grain *viz.*, hulling, milling and head recovery were done by using a composite sample in thrice replication.

For total N, available P and K content the semidry samples (0-15 cm depth) were collected before transplanting and after harvesting of crop and were estimated following Jackson (1973). Standard methods were followed to determined protein content (Sadasivam and Manickam, 1992) and amylase content (Juliano, 1971). The length of 10 kernals for each treatment was recorded by dial micrometer. Finally ground grain (after milling) and straw samples were used for determination of N, P and K content (Jackson, 1973). Total N, P and K uptake were calculated from grain and straw weight and their respective nutrient content.

Research Findings and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Grain and straw yield :

The data presented in the Table 1 reveal that there was a significant response of different nutrient resources @100:50:50 kg NPK ha^{-1} on grain and straw yield and their quality. Application of inorganic fertilizer with spray of cycocel recorded maximum grain (3.77 t ha^{-1}) and

straw yield (5.93 t ha^{-1}) followed by inorganic fertilizer alone treatment which recorded grain (3.68 t ha^{-1}) and straw (5.93 t ha^{-1}) yield. The cycocel is a growth retarder which restricts the vegetative growth and improve the reproductive growth. This might be reason which recorded higher yield than sole inorganic treatment. The organic resources 10t FYM ha^{-1} recorded maximum grain yield (3.31 t ha^{-1}) and straw (4.94 t ha^{-1}) the INM treatment recorded significantly at par yield with 100 per cent RDF as inorganic fertilizer treatment registering grain (3.5 t ha^{-1}) and straw (5.33 t ha^{-1}). The reason behind the higher yield in INM treatment might be due to improvement is nutrient supply with more organics which improve soil physico-chemical and biological properties by providing essential food to microbes (Subha *et al.*, 2004). It also increased the activity of soil enzyme responsible for conservation of conversion of unavailable form of nutrient to available form (Singh *et al.*, 2006). Similar results were also reported by Pandey *et al.* (2007); Kharub and Chander (2008) and Gupta and Sharma (2010).

Among the varieties local aromatic variety Kalanamak recorded maximum grain (4.01 t ha^{-1}) and straw (5.18 t ha^{-1}) followed by improved basmati (Vasumathi) recorded grain (3.76 t ha^{-1}) and straw (4.62 t ha^{-1}) and minimum by tarori basmati recorded grain (2.3 t ha^{-1}) and straw (4.04 t ha^{-1}). The maximum yield by local non-basmati aromatic rice variety Kalanamak may be because agro climatic condition of experimental site is suitable for production of Kalanamak. The improved basmati (Vasumathi) adjusted in better way than tarori basmati at experimental site. It shows that Kalanamak and improved basmati (Vasumathi) were more suitable for production at Inceptisol of Eastern Utter Pradesh. These results may be corroborated with the finding of Mohammed and Kumar (2001) and Subha *et al.* (2004).

Nutrient uptake by grain :

The data parenting nutrients (N, P, K, Zn, Ca and Mg) uptake by grain affected by different nutrient resources and aromatic varieties have been presented in Table 1. The maximum nutrient uptake were recorded by the treatments where 100 per cent RDF were supplemented with spray of cycocel N: 48.84, P: 20.30, K:10.83 kg ha^{-1} and Zn : 109.60, Ca: 1.94 and Mg: 4.3 g ha^{-1} followed by 100 per cent NPK with inorganic fertilizer which were significantly at par with INM and superior over organic manure (FYM) alone treatment. This may be attributed with higher yield due to availability of nutrient to the plants. The findings are in conformity with the findings of Singh *et al.* (2006); Pandey *et al.* (2007) and Yadav *et al.* (2013).

The variety Kalanamak recorded maximum nutrients

Table 1 : Effect of nutrient parameters on yield and quality of basmati/ aromatic rice **(Mean data of 2 years)**

Treatments	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Nutrient uptake in grain (kg ha^{-1})			g ha^{-1}		
			N	P_2O_5	K_2O	Zn	Ca	Mg
Only fertilizer N_1 100% NPK Inorganic fertilizers)	3.68	5.32	46.52	21.09	12.26	106.27	1.90	4.24
Organic manure+ fertilizer N_2 75% NPK+25%NPK FYM-N (5 t ha^{-1})	3.60	5.03	45.37	20.00	10.46	97.78	1.81	4.18
Organic manure N_2 100% FYM-N (10 t ha^{-1})	3.31	4.94	38.81	17.31	10.09	91.38	1.71	3.93
Fertilizer + cycobel N_4 100% NPK+ cycocel spray	3.77	5.93	48.84	20.30	10.83	109.60	1.94	4.30
C.D. (P=0.05)	0.06	0.12	2.2	0.83	0.90	12.9	NS	0.38
V_1 Vasumathi	3.76	4.62	43.94	20.18	10.58	104.36	1.98	3.90
V_2 Basumathi	2.30	4.04	29.64	13.42	7.47	69.77	1.23	2.34
V_3 Kalanamak	4.01	5.18	52.22	22.24	13.76	115.63	2.16	4.81
Experimental mean	3.47	5.05	43.47	19.22	10.77	99.25	21.46	3.95
Varities	0.05	0.11	1.9	0.87	0.8	10.3	0.43	0.34
Integration	NS	NS	NS	NS	NS	NS	NS	NS
C.V. (%)	12.10		9.0	15.7	15.7	22.0	437	17.5

NS= Non-significant

(N: 52.22, P: 22.24, K: 13.76 kg ha^{-1} and Zn: 115.63, Ca: 2.16 and Mg: 4.81 g ha^{-1}) followed by vasumathi and minimum by tarori basmati. The higher nutrient content and uptake might be due to higher yield and better root growth and development and capacity of variety to absorb higher amount of nutrients and translocation in grain. Similar findings are also reported by Gautam *et al.* (2005).

Quality of aromatic/ basmati rice :

The data pertaining effect of different nutrient resources and aromatic varieties on quality of aromatic / basmati rice are presented in Table 2. The application of nutrients as organic matter (100 FYM-N) and INM treatments generally improved the quality parameters as compared to 100 per cent NPK as inorganic fertilizer. The INM treatment 75 % inorganic fertilizer +25% (FYM-N) recorded significantly maximum hulling (78.6%), Milling (67.90), HRR (45.90) followed by fertilizer cycocel treatment over only fertilizer and only organic matter treatment 100 per cent FYM-N, other quality parameter KL (6.74 mm), KB (1.84 mm), LB ratio (3.72), VER (5.2), KL Al (12.60 mm), ASU (4.78), GC (61.6 mm) were also recorded maximum by INM treatment followed by fertilizer + cycocel treatment. But the differences were non-significant. The improvement in quality parameters due to INM treatment (75% fertilizer + 25% FYM-N) might be due to fact that the organic manure improves organic matter status of soil which is most important component of soil. Organic carbon helps to increase microbial and enzymatic activities of soil which ultimately improve the availability of macro and micro nutrients of soil which ultimately help to improve quality parameters of rice (Singh *et al.*, 2006; Yadav *et al.,* 2006 and Pandey *et al.*,2007). This result is in close conformity with the findings of Jadhav *et al.* (2003); Gautam *et al.* (2005) and Chander *et al.* (2005). The spray of cycocel related the vegetative growth of plant and ultimately improved the quality parameter over sole inorganic fertilizer treatment.

Among the varieties improved basmati (Vasumathi) registered significantly maximum hulling (79.5%), milling (68.6%), HRR (42.3), KL (7.36mm), KB (1.78mm) and AC (28.6) over tarori basmati and Kalanamak. Other quality parameters like VER, WU, KLAL, ASU ER and GC contents were registered maximum in vasumathi followed by Kalanamak but the differences were not significant. The grain type of vasumathi and T. basmati were long slender and Kalanamak was medium cylindrical. This might be the character of vasumathi which adopted better

Table 2: Influence of nutrient related parameters on quality of basmati/ aromatic rice

Treatments	Hullin g (%)	Milling (%)	HRR	KL (mm)	KB (mm)	L.B ratio	Grain type	VER	WU	KLAL (mm)	ASU	ER	AC	GC (mm)
N_1 Only fertilizer (100%NPK)	77.6	66.3	44.4	6.59	1.83	3.63		4.94	153.30	12.5	4.78	1.81	24.8	56.0
N_2 Organic manure + fertilizer (75% NPK + 25% FYM-N)	78.6	67.9	45.9	6.74	1.84	3.72		5.20	146.7	12.6	4.78	1.89	26.0	61.6
N_3 Only organic manure (100% FYM-N)	77.1	66.0	43.9	6.60	1.80	3.67		5.19	165.6	12.6	4.56	1.89	25.0	63.3
N_4 Fertilizer +cycocel	78.0	67.5	45.7	6.59	1.80	3.68		5.24	171.1	12.5	4.78	1.92	26.4	53.7
C.D. (P=0.05)	1.0	0.6	1.2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Variety														
V_1 Vasumathi	79.5	68.6	42.3	7.36	1.78	4.15	LS	5.13	145.0	12.5	4.58	1.64	28.6	68.0
V_2 T- Basmati	76.0	64.7	32.1	7.30	1.75	4.24	LS	5.36	181.7	14.1	4.67	1.89	24.2	60.7
V_3 Kalanamak	78.2	67.6	60.6	5.11	1.93	2.64	MS	4.94	150.8	11.0	4.92	2.11	24.3	47.2
Experimental mean														
C.D. (P= 0.05)	0.9	1.4	3.9	0.12	0.05	NS	NS	NS	29.4	0.4	NS	NS	1.0	
Verities														
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
C.V. (%)	1.3	2.6	10.1	-	-	-	-	8.7	21.9	4.0	8.6	-	4.7	4.5

HRR- Head recovery ratio, KL- Kernel length KB- Kernel breadth, VER- Volume expansion ratio, WU- Water uptake, KLAC – Kernel length, ASU- Alkali spreading value, ER- Elongation ratio, AC – Amylose content, GC- Gel consistency NS= Non-significant

in Inceptisol of Eastern U.P. as compared to other varieties tested. The interaction between nutrient resources and rice varieties were not significant. Different rice varieties shows different quality parameters at the same sit is also reported by Gautam *et al.* (2005).

It may be concluded from the study that to get the high quality aromatic rice in Inceptisol of Eastern U. P. the farmers may be advocated to supply 75% RDF NPK as inorganic fertilizer + 25% RDF as FYM-N.

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